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ARTICLES, PAPERS, AND PRESENTATIONS

Compiled by Joyce E. Turner
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FOREWORD

In accordance with the NASA Space Act of 1958 the MSFC has provided for the widest practicable and appropriate dissemination of information concerning its activities and the results thereof.

Since July 1, 1960, when the George C. Marshall Space Flight Center was organized, the reporting of scientific and engineering information has been considered a prime responsibility of the Center. Our credo has been that "research and development work is valuable, but only if its results can be communicated and made understandable to others."

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GEORGE C. MARSHALL SPACE FLIGHT CENTER
Marshall Space Flight Center, Alabama

**FY 1985 SCIENTIFIC AND TECHNICAL REPORTS,
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TM-86470 November 1984
FY 1984 Scientific and Technical Reports,
Articles, Papers, and Presentations. Com-
piled by Joyce E. Turner. Management
Operations Office. N85-13670

This document presents formal NASA technical reports, papers published in technical journals, and presentations by MSFC personnel in FY 84. It also includes papers of MSFC contractors.

After being announced in STAR, all of the NASA series reports may be obtained from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161.

The information in this report may be of value to the scientific and engineering community in determining what information has been published and what is available.

TM-86471 October 1984
Estimating Sunspot Number. Robert M.
Wilson, Edwin J. Reichmann, and Dieter L.
Teuber. Space Science Laboratory.
N85-10896

Using a 3-component sinusoidal fit of \bar{R}_{MAX} versus sunspot cycle number (where \bar{R}_{MAX} is the smoothed sunspot number at cycle maximum) for cycles 8 through 20, considered to be the most reliably known cycles, values of \bar{R}_{MAX} are projected for cycles 21 and 22.

TM-86472 October 1984
Signal-to-Noise Ratio for the Wide Field/
Planetary Camera of the Space Telescope.
D. E. Zissa. Information and Electronic
Systems Laboratory. N84-35235

Signal-to-noise ratios for the Wide Field Camera and Planetary Camera of the Space Telescope have been calculated as a function of integration time. Models of the optical systems and CCD detector arrays were used with a 27th visual magnitude point source and a 25th visual magnitude per arc-second² extended source. A 23rd visual magnitude per arc-second² background was assumed. The models predicted signal-to-noise

ratios of 10 within 4 hours for the point source centered on a single pixel. Signal-to-noise ratios approaching 10 are estimated for approximately 0.25 x 0.25 arc-second areas within the extended source after 10 hours integration.

TM-86473 October 1984
Results of the Technical Exchange Agree-
ment Between NASA and DuPont on the
Containerless Drop Tube Solidification of
NiAl₃. Space Science Laboratory.
N85-10087

The final results of the Drop Tube Solidification of NiAl₃ are presented. Problems associated with the utilization of a "dripper" furnace in the drop tube are discussed and the modification of experimental procedures required to achieve results are described. Sample microstructures of drop tube samples are compared with other samples. The dendrite arm spacings of drop tube samples are correlated with the rapid cooling rates.

TM-86474 October 1984
Optical Analysis of the Star-Tracker Tele-
scope for Gravity Probe. D. E. Zissa. Infor-
mation and Electronic Systems Laboratory.
N85-10888

A ray-trace modeling of the star-tracker telescope for Gravity Probe has been used to predict the character of the output signal and its sensitivity to fabrication errors. In particular, the impact of the optical subsystem on the requirement of 1 milliarc-second signal linearity over a ± 50 milliarc-second range has been examined. Photomultiplier and solid state detector options were considered. Recommendations are made.

TM-86475 September 1984
Optical Contacting for Gravity Probe Star
Tracker. J. J. Wright and D. E. Zissa. Infor-
mation and Electronic Systems Laboratory.
N85-10819

A star-tracker telescope, constructed entirely of fused silica elements optically contacted together, has been proposed to provide submilli-arc-second pointing accuracy for Gravity Probe.

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First this report provides a bibliography on optical contacting; the bonding of very flat, highly polished surfaces without the use of adhesives. Then results are presented from preliminary experiments on the strength of optical contacts including a tensile strength test in liquid helium. The report emphasizes the need for further study to verify an optical contacting method for the Gravity Probe star-tracker telescope.

TM-84676 November 1984
Research and Technology 1984 Annual
Report of the Marshall Space Flight Center.
Compiled by the Research and Technology
Office and Edited by Tauna W. Moorehead.
N85-13765

The Marshall Space Flight Center conducts research programs in space sciences, materials processing in space, and atmospheric sciences, as well as technology programs in such areas as propulsion, materials, processes, and space power. This Marshall Space Flight Center 1984 Annual Report on Research and Technology contains summaries of the more significant scientific and technical results obtained during FY-84.

TM-86477 August 1984
Mars Exploration, Venus Swingby and
Conjunction Class Mission Modes, Time
Period 2000 to 2045. Archie C. Young,
John A. Mulqueen, and James E. Skinner.
Program Development Office. N85-11961

Trajectory and mission requirement data is presented for Earth-Mars opposition class and conjunction class round trip stopover mission opportunities available during the time period year 2000 to year 2045. The opposition class mission employs the gravitational field of Venus to accelerate the space vehicle on either the outbound or inbound leg. The gravitational field of Venus was used to reduce the propulsion requirement associated with the opposition class mission. Representative space vehicle systems are sized to compare the initial mass required in low Earth orbit of one mission opportunity with another mission opportunity. The interplanetary space vehicle is made up of the spacecraft and the space vehicle acceleration system. The space

vehicle acceleration system consists of three propulsion stages. The first propulsion stage performs the Earth escape maneuver, the second stage brakes the spacecraft and Earth braking stage into the Mars elliptical orbit and effects the escape maneuver from the Mars elliptical orbit. The third propulsion stage brakes the mission module into an elliptical orbit at Earth return. The interplanetary space vehicle was assumed to be assembled in and depart from the Space Station circular orbit.

TM-86478 October 1984
Global Matrix of Thermospheric Density
Values for Selected Solar/Geomagnetic Con-
ditions and Spacecraft Orbital Altitudes.
Dale L. Johnson. Systems Dynamics Labora-
tory. N85-13409

Presented are selected thermospheric/exospheric global mean and extreme density values computed between 130 and 1100 km altitude. These values were generated from the MSFC/J70 reference orbital atmospheric model using different input conditions of solar flux and geomagnetic index, ranging from low to peak. Typical magnitudes of day-night density changes are presented, as an example, for use in space vehicle orbital analyses.

TM-86479 October 1984
An Electrochemical Study of Hydrogen
Uptake and Elimination by Bare and Gold-
Plated Waspaloy. Merlin D. Danford, Gordon
E. DeRamus, Jr., and James R. Lowery.
Materials and Processes Laboratory.
N85-11222

Two electrochemical methods for the determination of hydrogen concentrations in metals are discussed and evaluated. The take-up of hydrogen at a pressure of 5,000 psi by Waspaloy metal was determined experimentally at 24°C. It was found that the metal becomes saturated with hydrogen after an exposure time of about 1 hr. For samples charged with hydrogen at high pressure, most of the hydrogen is contained in the interstitial solid solution of the metal. For electrolytically charged samples, most of the hydrogen is contained as surface and subsurface hydrides. Hydrogen elimination rates were

determined for these two cases, with the rate for electrolytically charged samples being greater by over a factor of two. Theoretical effects of high temperature and pressure on hydrogen take-up and elimination by bare and gold plated Wasp-alloy metal was considered. The breakthrough point for hydrogen at 5,000 psi, determined experimentally, lies between a gold thickness of 0.0127 mm (0.0005 in.) and 0.0254 mm (0.001 in.) at 24°C.

Electropolishing was found to greatly reduce the uptake of hydrogen at high pressure by Wasp-alloy metal at 24°C. Possible implications of the results obtained in this study, as they apply to the turbine disk of the Space Shuttle Main Engine, are discussed.

TM-86480 October 1984

An Evaluation of Grease Type Ball Bearing Lubricants Operating in Various Environments (Final Status Report No. 8). E. L. McMurtrey. Materials and Processes Laboratory. N85-11239

Because many future spacecraft or space stations will require mechanisms to operate for long periods of time in environments which are adverse to most bearing lubricants, a series of tests has been completed to evaluate 38 grease-type lubricants in R-4 size bearings in five different environments for a 1-year period. Four repetitions of each test were made to provide statistical samples. These tests were also used to select four lubricants for 5-year tests in selected environments with five repetitions of each test for statistical samples. In this completed program, 172 test sets have been completed. The three 5-year tests in (1) continuous operation and (2) start-stop operation, with both in vacuum at ambient temperatures, and (3) continuous vacuum operation at 93.3°C have been completed. In both the 1-year and 5-year tests, the best results in all environments have been obtained with a high viscosity index perfluoroalkylpolyether (PFPE) grease.

TM-86482 November 1984

The Variable Polarity Plasma Arc Welding Process: Its Application to the Space Shuttle External Tank — Second Interim Report.

A. C. Nunes, Jr., E. O. Bayless, Jr., and W. A. Wilson. Materials and Processes Laboratory N85-14115

This report describes progress in the implementation of the Variable Polarity Plasma Arc Welding (VPPAW) process at the External Tank (ET) assembly facility. Design allowable data has been developed for thicknesses up to 1.00 in. More than 24,000 in. of welding on liquid oxygen and liquid hydrogen cylinders has been made without an internal defect.

TM-86483 December 1984

Improving the Spacelab Mass Memory Unit Tape Layout with a Simulation Model. Steven R. Noneman. Systems Analysis and Integration Laboratory. N85-14571

A tape drive called the Mass Memory Unit (MMU) stores software used by Spacelab computers. MMU tape motion must be minimized during typical flight operations to avoid a loss of scientific data. A projection of the tape motion is needed for evaluation of candidate tape layouts. A computer simulation of the scheduled and unscheduled MMU tape accesses is developed for this purpose. This simulation permits evaluations of candidate tape layouts by tracking and summarizing tape movements. The factors that affect tape travel are investigated and a heuristic is developed to find a "good" tape layout. An improved tape layout for Spacelab I is selected after the evaluation of fourteen candidates. The simulation model will provide the ability to determine MMU layouts that substantially decrease the tape travel on future Spacelab flights.

TM-86484 October 1984

Atmospheric Environment for Space Shuttle (STS-41D) Launch. D. L. Johnson, C. K. Hill, G. Jasper, and G. W. Batts. Systems Dynamics Laboratory. N85-14358

This report presents a summary of selected atmospheric conditions observed near Space Shuttle STS-41D launch time on August 30, 1984, at Kennedy Space Center, Florida. Values of ambient pressure, temperature, moisture, ground winds, visual observations (cloud), and

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winds aloft are included. The sequence of pre-launch Jimsphere measured vertical wind profiles is given in this report. Also presented are wind and thermodynamic parameters representative of surface and aloft conditions in the SRB descent/impact ocean area. Final atmospheric tapes, which consist of wind and thermodynamic parameters versus altitude, for STS-41D vehicle ascent and SRB descent/impact have been constructed. The STS-41D ascent meteorological data tape has been constructed by Marshall Space Flight Center's Atmospheric Sciences Division to provide an internally consistent data set for use in post flight performance assessments.

TM-86486 November 1984
Atmospheric Environment for Space Shuttle (STS-41G) Launch. D. L. Johnson, C. K. Hill, G. Jasper, and G. W. Batts. Systems Dynamics Laboratory. N85-16320

This report presents a summary of selected atmospheric conditions observed near Space Shuttle STS-41G launch time on October 5, 1984, at Kennedy Space Center Florida. Values of ambient pressure, temperature, moisture, ground winds, visual observations (cloud), and winds aloft are included. The sequence of pre-launch Jimsphere measured vertical wind profiles is given in this report. The final atmospheric tape, which consists of wind and thermodynamic parameters versus altitude, for STS-41G vehicle ascent has been constructed. The STS-41G ascent atmospheric data tape has been constructed by Marshall Space Flight Center's Atmospheric Sciences Division to provide an internally consistent data set for use in post flight performance assessments.

TM-86487 January 1985
Monodisperse Latex Reactor (MLR) - A Materials Processing Space Shuttle Mid-Deck Payload. Dale M. Kornfeld. Space Science Laboratory. N85-21187

The Monodisperse Latex Reactor experiment has flown five times on the space shuttle, with three more flights currently planned. The objective of this project is to manufacture, in the microgravity environment of space, large particle-size monodisperse polystyrene latexes in

particle sizes larger and more uniform than can be manufactured on Earth. Historically it has been extremely difficult, if not impossible, to manufacture in quantity very high quality monodisperse latexes on Earth in particle sizes much above several micrometers in diameter due to buoyancy and sedimentation problems during the polymerization reaction. However the MLR project has succeeded in manufacturing in microgravity monodisperse latex particles as large as 30 micrometers in diameter with a standard deviation of 1.4 percent. It is expected that 100 micrometer particles will have been produced by the completion of the three remaining flights.

These tiny, highly uniform latex microspheres have become the "FIRST SPACE PRODUCT," that is, the first material ever to be commercially marketed that was manufactured in space. The U.S. National Bureau of Standards has certified the first batch of "space latex," which was transferred to NBS by NASA in July 1984, and they will begin marketing this material in mid-1985 as the U.S. national 10-micrometer Standard Reference Material.

TM-86488 December 1984
A Numerical Method for Interface Problems in Elastodynamics. David S. McGhee. Systems Dynamics Laboratory. N85-17391

This study deals with the numerical implementation of a formulation for a class of interface problems in elastodynamics. This formulation combines the use of the finite element and boundary integral methods to represent the interior and the exterior regions, respectively. In particular, the response of a semicylindrical alluvial valley in a homogeneous halfspace to incident antiplane SH waves is considered to determine the accuracy and convergence of the numerical procedure. Numerical results are obtained for several combinations of the incidence angle, frequency of excitation and relative stiffness between the inclusion and the surrounding halfspace. The results tend to confirm the theoretical estimates, that the convergence is of the order h^2 for the piecewise linear elements used. It is also observed that the accuracy decreases as the frequency of excitation increases or as the relative stiffness of the inclusion decreases.

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TM-86489 February 1985
Ground Test Experiment for Large Space Structures. Danny K. Tollison and Henry B. Waites. Systems Dynamics Laboratory.
N85-19013

In recent years, a new body of control theory has been developed for the design of control systems for Large Space Structures (LSS). The problems of testing this theory on LSS hardware are aggravated by the expense and risk of actual "in orbit" tests. Ground tests on large space structures can provide a proving ground for candidate control systems, but such tests require a unique facility for their execution. The current development of such a facility at the NASA Marshall Space Flight Center (MSFC) is the subject of this report.

TM-86490 February 1985
Active Control of Large Space Structures: An Introduction and Overview. G. B. Doane, D. K. Tollison, and H. B. Waites. Systems Dynamics Laboratory.
N85-19014

An overview of the Large Space Structure (LSS) control system design problem is presented. The LSS is defined as a class of system and LSS modeling techniques are discussed. Included are discussions concerning model truncation, control system objectives, current control law design techniques, and particular problem areas.

TM-86491 February 1985
NASA-VCOSS Dynamic Test Facility. Dr. Henry B. Waites, Dr. Sherman M. Seltzer, and Dr. George B. Doane III. Systems Dynamics Laboratory.
N85-18998

This report describes the Large Space Structure Ground Test Facility under development at the NASA Marshall Space Flight Center in Huntsville, Alabama. It presents the status of the tests being performed and the present and proposed utilization of that facility by DOD. The Ground Test Facility was established initially to test experimentally the control system to be used on the Solar Array Flight Experiment. Further, the structural dynamics of the selected test article were to be investigated, including the fidelity of the associated mathematical model. It became

apparent that many of the LSS objectives of NASA were similar to those of DARPA and the US Air Force. In particular, all three agencies are interested in a Government test facility that can accommodate large structures emulating actual space systems. The facility must permit the investigation of structural dynamics phenomena and be able to evaluate candidate attitude control and vibration suppression techniques.

TM-86492 February 1985
Test and Evaluation of the 2.4-m Photorefractor Ocular Screening System. John R. Richardson. Technology Utilization Office.
N85-26115

This report presents a test and evaluation of an improved 2.4-m photorefractor ocular screening system, jointly developed by Medical Sciences Corporation and the Marshall Space Flight Center.

The photorefractor system works on the principal of obtaining a colored photograph of both human eyes; and, by analysis of the retinal reflex images, certain ocular defects can be detected such as refractive error, strabismus, and lens obstructions.

The 2.4-m photorefractor system uses a 35-mm camera with a telephoto lens and an electronic flash attachment. Retinal reflex images obtained from the new 2.4-m system are significantly improved over earlier systems in image quality. Other features were also improved, notably portability and reduction in mass.

A total of 706 school age children were photorefracted, 211 learning disabled and 495 middle school students. The total students having abnormal reflexes were 156 or 22 percent, and 133 or 85 percent of the abnormal had refractive error indicated. Ophthalmological examination was performed on 60 of these students and refractive error was verified in 57 or 95 percent of those examined.

The new 2.4-m system has a NASA patent pending and is authorized by the FDA. It provides a reliable means of rapidly screening the eyes of children and young adults for vision

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problems. It is especially useful for infants and other non-communicative children who cannot be screened by the more conventional methods such as the familiar "E" chart.

TM-86493 January 1985
Space Shuttle Booster Thrust Imbalance Analysis. William R. Bailey and Douglas L. Blackwell. Systems Analysis and Integration Laboratory. N85-21241

This report presents an analysis of the Shuttle SRM thrust imbalance during the steady-state and tailoff portions of the boost phase of flight. The study includes results from flights STS-1 through STS-13. A statistical analysis of the observed thrust imbalance data is presented. A 3σ thrust imbalance history versus time has been generated from the observed data and is compared to the vehicle design requirements. The effect on Shuttle thrust imbalance from the use of replacement SRM segments is predicted. Comparisons of observed thrust imbalances with respect to predicted imbalances are presented for the two Space Shuttle flights which used replacement aft segments (STS-9 and STS-13).

TM-86494 February 1985
Determination of the Gaseous Hydrogen Ductile-Brittle Transition in Copper-Nickel Alloys. R. A. Parr, M. H. Johnston, J. H. Davis, and T. K. Oh. Materials and Processes Laboratory.

A series of copper-nickel alloys were fabricated, notched tensile specimens machined, for each alloy and the specimens tested in 34.5 MPa hydrogen and in air. A notched tensile ratio was determined for each alloy and the hydrogen environment embrittlement (HEE) determined for the alloys of 47.7 weight percent nickel to 73.5 weight percent nickel.

Stacking fault probability and stracking fault energies were determined for each alloy using the X-ray diffraction line shift and line profiles technique.

Hydrogen environment embrittlement was determined to be influenced by stacking fault energies; however, the correlation is believed to

be indirect and only partially responsible for the HEE behavior of these alloys.

TM-86495 November 1984
Definition of Ground Test for Large Space Structure (LSS) Control Verification. H. B. Waites, G. B. Doane, III and Danny K. Tollison. Systems Dynamics Laboratory. N85-21249

An overview for the definition of a ground test for the verification of Large Space Structure (LSS) control is given. The definition contains information on the description of the LSS ground verification experiment, the project management scheme, the design, development, fabrication and checkout of the subsystems, the systems engineering and integration, the hardware subsystems, the software, and a summary which includes future LSS ground test plans. Upon completion of these items, NASA/MSFC will have an LSS ground test facility which will provide sufficient data on dynamics and control verification of LSS so that LSS flight system operations can be reasonably ensured.

TM-86496 December 1984
NASA/MSFC Ground Experiment for Large Space Structure Control Verification. Henry B. Waites, Sherman M. Seltzer, and Danny K. Tollison. Systems Dynamics Laboratory. N85-21248

NASA Marshall Space Flight Center has developed a facility in which closed loop control of Large Space Structures (LSS) can be demonstrated and verified. The main objective of the facility is to verify LSS control system techniques so that on-orbit performance can be ensured. The facility consists of an LSS test article which is connected to a payload mounting system that provides control torque commands. It is attached to a base excitation system which will simulate disturbances most likely to occur for Orbiter and DOD payloads. A control computer will contain the calibration software, the reference system, the alignment procedures, the telemetry software, and the control algorithms. The total system will be suspended in such a fashion that the LSS test article has the characteristics common to all LSS.

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TM-86497 December 1984
Atmospheric Environment for Space Shuttle
(STS-51A) Launch. D. J. Johnson, G.
Jasper, C. K. Hill, and G. W. Batts. Systems
Dynamics Laboratory. N85-21875

This report presents a summary of selected atmospheric conditions observed near Space Shuttle STS-51A launch time on November 8, 1984, at Kennedy Space Center Florida. Values of ambient pressure, temperature, moisture, ground winds, visual observations (cloud), and winds aloft are included. The sequence of pre-launch Jimsphere measured vertical wind profiles is given in this report. The final atmospheric tape, which consists of wind and thermodynamic parameters versus altitude, for STS-51A vehicle ascent has been constructed. The STS-51A ascent atmospheric data tape has been constructed by Marshall Space Flight Center's Atmospheric Sciences Division to provide an internally consistent data set for use in post flight performance assessments.

TM-86498 March 1985
Natural Environment Design Criteria for the
Space Station Definition and Preliminary
Design (Second Revision). William W.
Vaughan and Claude E. Green. Systems
Dynamics Laboratory. N85-21232

This document provides the natural environment design criteria for the Space Station Program (SSP) definition and preliminary design. It addresses the atmospheric dynamic and thermodynamic environments, meteoroids, radiation, magnetic fields, physical constants, etc., and is intended to enable all groups involved in the definition and preliminary design studies to proceed with a common and consistent set of natural environment criteria requirements. The Space Station Program Elements (SSPE) shall be designed with no operational sensitivity to natural environment conditions during assembly, check-out, stowage, launch, and orbital operations to the maximum degree practical.

TM-86499 April 1985
Introduction to the Space Physics Analysis
Network (SPAN) – First Edition. The Data

Systems Users Working Group. Space
Science Laboratory. N85-24198

The Space Physics Analysis Network or SPAN is emerging as a viable method for solving an immediate communication problem for the space scientist. SPAN provides low-rate communication capability with co-investigators and colleagues, and access to space science data bases and computational facilities. The SPAN utilizes up-to-date hardware and software for computer-to-computer communications allowing binary file transfer and remote log-on capability to over 25 nationwide space science computer systems. SPAN is not discipline or mission dependent with participation from scientists in such fields as magnetospheric, ionospheric, planetary, and solar physics.

This document provides basic information on the network and its use. It is anticipated that SPAN will grow rapidly over the next few years, not only from the standpoint of more network nodes, but as scientists become more proficient in the use of telescience, more capability will be needed to satisfy the demands.

TM-86500 May 1985
Span Graphics Display Utilities Handbook
(First Edition). Dennis L. Gallagher, James
L. Green, and Robert Newman. Space
Science Laboratory. N85-27567

The Space Physics Analysis Network (SPAN) is a computer network connecting scientific institutions throughout the United States. This network provides an avenue for timely, correlative research between investigators, in a multidisciplinary approach to space physics studies. An objective in the development of SPAN is to make available direct and simplified procedures that scientists can use, without specialized training, to exchange information over the network. Information exchanges include raw and processed data, analysis programs, correspondence, documents, and graphic images. This handbook details procedures that can be used to exchange graphic images over SPAN.

The intent is to periodically update this handbook to reflect the constantly changing

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facilities available on SPAN. The utilities described within reflect an earnest attempt to provide useful descriptions of working utilities that can be used to transfer graphic images across the network. Whether graphic images are representative of satellite observations or theoretical modeling and whether graphics images are of device dependent or independent type, the SPAN graphics display utilities handbook will be the users guide to graphic image exchange.

TM-86501 May 1985
Preliminary Study of Inphase Gusts and Moment Force Wind Loads Over the First 150 Meters at KSC, Florida. John W. Kaufman. Systems Dynamics Laboratory.
N85-23273

Initial results have been completed on a mathematical/statistical analysis of inphase gusts and wind velocity moment forces over the first 150 m at the Kennedy Space Center, Florida. The wind velocity profile data used in the analysis were acquired at the KSC 150 m Ground Wind Tower. The results show that planetary boundary layer (PBL) winds can sustain near-peak speeds for periods up to 60 sec and longer. This is proven from calculating the auto-correlation functions of moment forces for several 10-min cases of wind profile data. Although this analysis is preliminary, the results prove that lower atmospheric planetary boundary layer winds do have a periodic variation for long periods of time. This flow characteristic is valuable as aerospace vehicle engineering and design criteria where wind loading must be determined. Such information is also important to the aviation and surface transportation engineers.

TM-86502 February 1985
BIG MAC: A Bolometer Array for Mid-Infrared Astronomy, Center Director's Discretionary Fund Final Report. C. M. Tesesco, R. Decher, and C. Baugher. Space Science Laboratory.
N85-23463

This report describes the infrared array developed in the Space Science Laboratory at Marshall Space Flight Center with Center Director's Discretionary Funds. The array, referred to as Big Mac (for Marshall Array Camera), was

designed for ground-based astronomical observations in the wavelength range 5 to 35 μm . It contains 20 discrete gallium-doped germanium bolometer detectors at a temperature of 1.4K. Each bolometer is irradiated by a square field mirror constituting a single pixel of the array. The mirrors are arranged contiguously in four columns and five rows, thus defining the array configuration. Big Mac utilizes cold re-imaging optics and an up-looking dewar. The total Big Mac system also contains a telescope interface tube for mounting the dewar and a computer for data acquisition and processing. Initial astronomical observations at a major infrared observatory indicate that Big Mac performance is excellent, having achieved the design specifications and making this instrument an outstanding tool for astrophysics.

TM-86503 August 1985
A Comparison of the Physics of Gas Tungsten Arc Welding (GTAW), Electron Beam Welding (EBW), and Laser Beam Welding (LBW). A. C. Nunes, Jr. Materials and Processes Laboratory.

The physics governing the applicability and limitations of gas tungsten arc (GTA), electron beam (EB), and laser beam (LB) welding are compared. An appendix on the selection of laser welding systems is included.

TM-86505 March 1985
Preparation of Silicon Carbide-Silicon Nitride Fibers by the Pyrolysis of Polycarbosilazane Precursors (Center Director's Discretionary Fund Final Report. B. G. Penn, J. G. Daniels, F. E. Ledbetter, III and J. M. Clemons. Space Science Laboratory.
N85-28107

The development of silicon carbide-silicon nitride fibers ($\text{SiC-Si}_3\text{N}_4$) by the pyrolysis of polycarbosilazane precursors that was carried out in this laboratory is reviewed. Precursor resin, which was prepared by heating tris(N-methylamino)-methylsilane or tris(N-methylamino)phenylsilane to about 520°C, was drawn into fibers from the melt and then made unmeltable by humidity conditioning at 100°C and 95 percent relative humidity. The humiditytreated

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precursor fibers were pyrolyzed to ceramic fibers with good mechanical properties and electrical resistivity. For example, $\text{SiC-Si}_3\text{N}_4$ fibers derived from tris(n-methylamino)methylsilane had a tensile rupture modulus of 29×10^6 psi and electrical resistivity of $6.9 \times 10^8 \Omega\text{-cm}$ which is 10^{12} times greater than that obtained for graphite fibers.

This research was sponsored by the MSFC Center Director's Discretionary Fund Project [No. 82-13, "Preparation of New Continuous Silicon Carbide-Silicon Nitride ($\text{SiC-Si}_3\text{N}_4$) Fibers by the Controlled Pyrolysis of Organosilane Polymeric Precursors"].

TM-86506 April 1985
Solar Array Flight Experiment. Jerry Slaby.
Systems Dynamics Laboratory. N85-27935

This is a closed form solution for the longitudinal oscillation of the Solar Array Flight Experiment (SAFE) blanket for all phases of deployment. The frequency response shows that the blanket frequency increases shortly before full deployment. That fact causes a coupling between the mast and the blanket frequency but, because of the relatively high speed of deployment, a buildup of resonance is unlikely.

TM-86507 March 1985
The Extended Range X-Ray Telescope,
Center Director's Discretionary Fund Final
Report. R. B. Hoover, N. P. Cumings, E.
Hildner, R. L. Moore, and E. A. Tandberg-
Hanssen. Space Science Laboratory.
N85-30983

An Extended Range X-Ray Telescope (ERXRT) of high sensitivity and spatial resolution capable of functioning over a broad region of the X-ray/XUV portion of the spectrum has been designed and analyzed. This system has been configured around the glancing-incidence Wolter Type I X-ray mirror system which was flown on the Skylab Apollo Telescope Mount as ATM Experiment S-056. Enhanced sensitivity over a vastly broader spectral range can be realized by the utilization of a thinned, back-illuminated, buried-channel Charge Coupled Device (CCD)

as the X-ray/XUV detector rather than photographic film. However, to maintain the high spatial resolution inherent in the X-ray optics when a CCD of 30 micron pixel size is used, it is necessary to increase the telescope plate scale. This can be accomplished by use of a glancing-incidence X-ray microscope to enlarge and re-focus the primary image onto the focal surface of the CCD.

In the ERXRT program, several glancing-incidence hyperboloid/ellipsoid X-ray microscope optical elements were designed and analyzed. An 8X microscope of 2-m focal length was selected as the optimum configuration to couple the S-056 X-ray mirrors to a 30-micron pixel RCA CCD X-ray/XUV detector. Detailed ray trace analysis studies have shown that this system has theoretical performance which should permit sub-arc second images to be achieved over the entire field of view of the detector. This research has shown that the ERXRT concept is theoretically feasible and that this system may be of great value for future high-resolution X-ray telescope/X-ray spectroscopy instruments. It has also provided valuable insights into other hybrid X-ray optical systems, such as are now being developed in the Wolter/LSM X-ray telescope program, which is also a Center Director's Discretionary Fund program.

TM-86508 April 1985
Atmospheric Environment for Space Shuttle
(STS-51C) Launch. G. L. Jasper, D. L.
Johnson, C. K. Hill, and G. W. Batts. Sys-
tems Dynamics Laboratory. N85-30547

This report presents a summary of selected atmospheric conditions observed near Space Shuttle STS-51C launch time on January 24, 1985, at Kennedy Space Center, Florida. Values of ambient pressure, temperature, moisture, ground winds, visual observations (cloud), and winds aloft are included. The sequence of pre-launch Jimsphere measured vertical wind profiles is given in this report. The final atmospheric tape, which consists of wind and thermodynamic parameters versus altitude, for STS-51C vehicle ascent has been constructed. The STS-51C ascent atmospheric data tape has been constructed

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by Marshall Space Flight Center's Atmospheric Sciences Division to provide an internally consistent data set for use in post flight performance assessments.

TM-86509 June 1985
Space Shuttle Molecular Scattering and Wake Vacuum Measurements. R. J. Naumann, G. R. Carignan, and E. R. Miller. Space Science Laboratory. N85-29978

The wake environment of the space shuttle is analyzed to determine whether it is feasible to perform ultra-high vacuum experiments in or near the payload bay with the shuttle oriented such that the payload bay faces the anti-velocity direction. Several mechanisms were considered by which molecules could approach the payload bay from this direction and their relative contributions to the wake environment are estimated. These mechanisms include ambient atmospheric molecules that have velocities in excess of the orbital velocity which can overtake the shuttle, ambient atmospheric molecules that are back-scattered by collisions with the shuttle-induced atmosphere, and self-scattering from the induced atmosphere.

These estimates are compared with the measurements made with the collimated mass spectrometer which was part of the Induced Environment Contamination Monitor flown on several of the early shuttle flights. Although the collimated mass spectrometer was not designed for this purpose and the instrument background for the species for which the collimator is effective is above the expected levels, upper limits can be established for these species in the wake environment which are consistent with the analysis. There was considerably more helium and argon observed in the wake direction that was predicted, however. Possible origins of these gases are discussed.

TM-86510 April 1985
Docking Simulation Analysis of Range Data Requirements for the Orbital Maneuvering Vehicle. James D. Micheal and Frank L. Vinz. Systems Dynamics Laboratory. N85-31143

This report describes the approach and results of an initial study to assess the controllability of the Orbital Maneuvering Vehicle (OMV) for terminal closure and docking. The vehicle characteristics used in this study are those of the Marshall Space Flight Center (MSFC) baseline OMV which were published with the Request for Proposals for preliminary design of this vehicle. This simulation was conducted at MSFC using the Target Motion Simulator. The study focused on the OMV manual mode capability to accommodate both stabilized and tumbling target engagements with varying complements of range and range rate data displayed to the OMV operator. Four trained test subjects performed over 400 simulated orbital dockings during this study. A firm requirement for radar during the terminal closure and dock phase of the OMV mission was not established by these simulations. Fifteen pound thrusters recommended in the MSFC baseline design were found to be advantageous for initial rate matching maneuvers with unstabilized targets; however, lower thrust levels were desirable for making the final docking maneuvers.

TM-86511 June 1985
Hubble Space Telescope — Pointing Error Effects on Nonlinear Ball Joints. John E. Farmer and Floyd R. Grissett. Systems Dynamics Laboratory. N85-32058

The purpose of this report is to examine the Hubble Space Telescope pointing error produced by optical benches mounted on free ball joints. Spacecraft cable connections are assumed to produce translational and rotational damping and restoring forces which act through the optical bench center of mass. The nonlinear dynamics are modeled and then implemented using an existing computer program for simulating the vehicle dynamics and pointing control system algorithm. Results are presented for the test case which indicate acceptable performance.

TM-86512 June 1985
Development and Test of Advanced Composite Components, Center Director's Discretionary Fund Program. G. Faile, R. Hollis, F. Ledbetter, J. Maldonado, J. Sledd, J. Stuckey, G. Waggoner, and E. Engler.

NASA TECHNICAL MEMORANDUM

Structures and Propulsion Laboratory.

N85-32147

This report describes the design, analysis, fabrication, and test of a complex "bathtub fitting." Graphite fibers (P75) in an epoxy matrix were utilized in manufacturing of 11 components representing four different design and layup concepts. Design allowables were developed for use in the final stress analysis. Strain gage measurements were taken throughout the static load test and correlation of test and analysis data were performed, yielding good understanding of the material behavior and instrumentation requirements for future applications.

TM-86513

August 1985

Analytical Investigation of Solid Rocket Nozzle Failure. Dr. Kenneth E. McCoy and J. Hester. Structures and Propulsion Laboratory.

On April 5, 1983, an Inertial Upper Stage (IUS) spacecraft experienced loss of control during the burn of the second of two solid rocket motors. The anomaly investigation showed the cause to be a malfunction of the solid rocket motor. This paper presents a description of the IUS system, a failure analysis summary, an account of the thermal testing and computer modeling done at Marshall Space Flight Center, a comparison of analysis results with thermal data obtained from motor static tests, and describes some of the design enhancements incorporated to prevent recurrence of the anomaly.

TM-86514

July 1985

Improved Turbopump Dynamics, Center Director's Discretionary Fund Final Report. Larry Kiefling. Systems Dynamics Laboratory.

N85-31509

A study was initiated to investigate the practicality of increasing rotor critical speeds by changes in manufacturing method. The technique would be to build a pump with an all-laser-welded shaft and case; such unit to be opened by laser cutting and rebuilt by rewelding the same surface. Use of a split casing, common in industry, would permit assembly of the rotor outside the case.

A team was formed to perform the study; however, the work of the team was severely restricted by conflict with higher priority tasks. No manpower was available to evaluate alternate configurations. Thus, much of the synergetic effects of cohesive design modification was lost. Although very limited results were achieved, nothing was found to indicate that the method is not worth further investigation.

TM-86515

July 30, 1985

Weibull Distribution Based on Maximum Likelihood with Interval Inspection Data. Mario H. Rheinfurth. Systems Dynamics Laboratory.

N85-32847

This technical note determines the two Weibull parameters based upon the method of maximum likelihood as presented in memorandum, "Oxidizer Turbine (HPOTP) First Stage Blade Reliability Analysis," dated July 10, 1985, by the author. The test data used were failures observed at inspection intervals. The application was the reliability analysis of the SSME oxidizer turbine blades.

TM-86516

July 1985

Surface Voltage Gradient Role in High Voltage Solar Array/Plasma Interactions -- Center Director's Discretionary Fund Final Report. M. R. Carruth, Jr. Space Science Laboratory.

A large amount of experimental and analytical effort has been directed toward understanding the plasma sheath growth and discharge phenomena which lead to high voltage solar array-space plasma interactions. An important question which has not been addressed is how the surface voltage gradient on such an array may affect these interactions. The results of this study indicate that under certain conditions, the voltage gradient should be taken into account when evaluating the effect on a solar array operating in a plasma environment.

TM-86517

July 1985

Hardware Math for the 6502 Microprocessor. Ralph Kissel and James Currie. Information and Electronic Systems Laboratory.

NASA TECHNICAL MEMORANDUM

A floating-point arithmetic unit is described which is being used in the Ground Facility for Large Space Structures Control Verification (GF/LSSCV). The experiment uses two complete inertial measurement units and a set of three gimbal torquers in a closed loop to control the structural vibrations in a flexible test article (beam). A 6502 (8-bit) microprocessor controls four AMD 9511A floating-point arithmetic units to do all the computation in 20 milliseconds.

TM-86519

October 1985

The Role of Tethers on Space Station.
Georg von Tiesenhausen, Editor. Program
Development.

This report describes the results of research and development that addressed the usefulness of tether applications in space, particularly for space station. A well organized and structured effort of considerable magnitude involving NASA, industry and academia have defined the engineering and technological requirements of space tethers and their broad range of economic and operational benefits. This report consolidates the work directed by seven NASA Field Centers and is structured to cover the general and specific roles of tethers in space as they apply to NASA's planned space station. This is followed by a description of tether systems and operation. The report closes with a summary of NASA's plans for tether applications in space for years to come.

TP-2396 September 1984
 Algorithm for Astronomical, Extended
 Source, Signal to Noise Ratio Calculations.
 R. R. Jayroe. Information and Electronic
 System Laboratory. N85-12833

An algorithm was developed to simulate the expected signal-to-noise ratio as a function of observation time in the charge coupled device detector plane of an optical telescope located outside the Earth's atmosphere for an extended, uniform astronomical source embedded in a uniform cosmic background. By choosing the appropriate input values, the expected extended source signal-to-noise ratios can be computed for the Hubble Space Telescope using the Wide Field/Planetary Camera science instrument.

TP-2397 September 1984
 Algorithm for Astronomical, Point Source,
 Signal to Noise Ratio Calculations. R. R.
 Jayroe and D. J. Schroeder. Information
 and Electronics System Laboratory.
 N85-12834

An algorithm was developed to simulate the expected signal to noise ratios as a function of observation time in the charge coupled device detector plane of an optical telescope located outside the Earth's atmosphere for a signal star, and an optional secondary star, embedded in a uniform cosmic background. By choosing the appropriate input values, the expected point source signal to noise ratio can be computed for the Hubble Space Telescope using the Wide Field/Planetary Camera science instrument.

TP-2425 November 1984
 An Evaluation and Comparison of Vertical
 Profile Data from the VISSR Atmospheric
 Sounder (VAS). Gary J. Jedlovec. Systems
 Dynamics Laboratory. N85-16351

A statistical evaluation is used to compare vertical profiles of temperature and moisture derived from VAS with three different algorithms to that of corresponding rawinsonde measurements for a clear-cold environment. To account for time and space discrepancies between the data sets, rawinsonde data were adjusted to be representative of the satellite sounding times.

Both rawinsonde and satellite sounding data were objectively analyzed onto a mesoscale grid. These grid point values were compared at 50 mb pressure increments from the surface up to 100 mb. The data were analyzed for horizontal and vertical structure, representativeness of derived parameters, and significant departure (improvement) from the apriori (first guess) information.

Results indicate some rather strong temperature and moisture biases exist in the satellite soundings. Temperature biases of 1° to 4°C and dewpoint biases of 2° to 6°C generally occur in layers where strong inversions are present and vary with time as these atmospheric features evolve. The biases also change as a function retrieval scheme suggesting limitations and restrictions on the applications of the various techniques. Standard temperature deviations range from 1° to 2°C for each retrieval scheme with maximum values around 800 to 400 mb. Derived parameters (precipitable water and thickness) suffer from similar biases, though to a somewhat lesser extent. Gradients of basic and derived parameters are generally weaker but have good horizontal structure where magnitudes of the parameters are relatively strong. Integrated thermal (temperature) and moisture (precipitable water) parameters show mixed results. Although biases are small in the precipitable water values from the regression scheme, horizontal structure is poor.

An analysis of apriori and first guess information show similar biases when compared to the ground truth measurements. This information, however, seems to provide the majority of the vertical structural information present in the VAS retrievals.

TP-2448 February 1985
 A New NASA/MSFC Mission Analysis
 Global Cloud Cover Data Base. S. C. Brown
 and W. R. Jeffries, III. Systems Dynamics
 Laboratory. N85-21878

A global cloud cover data set, derived from the USAF 3D NEPH Analysis, has been developed for use in climate studies and for Earth viewing applications. This data set contains a single parameter — total sky cover -- separated in time

by 3 or 6 hr intervals and in space by approximately 50 n.mi. Cloud cover amount is recorded for each grid point (of a square grid) by a single alphanumeric character representing each 5 percent increment of sky cover.

The data are arranged in both quarterly and monthly formats. A quarterly format computer tape usually contains 3 months of data for one hemisphere while each monthly format tape contains up to 5 years of 1 month for one hemisphere.

Although there are gaps in the data, notably all of 1976 for the Northern Hemisphere, the data base currently provides daily, 3-hr observed total sky cover for the Northern Hemisphere (NH) from 1972 through 1977 less 1976. For the Southern Hemisphere (SH), there are data at 6-hr intervals for 1976 through 1978 and at 3-hr intervals for 1979 and 1980. More years of data are being added in both hemispheres.

To validate the data base, the percent frequency of ≤ 0.3 and ≥ 0.8 cloud cover was compared with ground observed cloud amounts at several locations with generally good agreement.

Mean or other desired cloud amounts can be calculated for any time period and any size area from a single grid point to a hemisphere.

The data base is especially useful in evaluating the consequence of cloud cover on Earth viewing space missions. The temporal and spatial frequency of the data allow simulations that closely approximate any projected viewing mission. The greatest attribute is that no adjustments are required to account for cloud continuity.

TP-2450 January 1985
Three-Dimensional Baroclinic Instability of a Hadley Cell for Small Richardson Number. Basil N. Antar and William W. Fowles. Space Science Laboratory. N85-20605

A three-dimensional, linear stability analysis of a baroclinic flow for Richardson number, Ri , of order unity is presented. The model considered is a thin horizontal, rotating fluid layer which

is subjected to horizontal and vertical temperature gradients. The basic state is a Hadley cell which is a solution of the complete set of governing, nonlinear equations and contains both Ekman and thermal boundary layers adjacent to the rigid boundaries; it is given in a closed form. The stability analysis is also based on the complete set of equations; and perturbations possessing zonal, meridional, and vertical structures were considered. Numerical methods were developed for the stability problem which results in a stiff, eighth-order, ordinary differential eigenvalue problem. The objectives of this work were to extend the previous work on three-dimensional baroclinic instability for small Ri to a more realistic model involving the Prandtl number, σ , and the Ekman number, E , and to finite growth rates and a wider range of the zonal wavenumber. The study covers ranges of $0 < Ri \leq 1.1$, $0.2 \leq \sigma \leq 5.0$, and $E = 10^{-3}$. For the cases computed, it was found for $\sigma \leq 1$ that conventional baroclinic instability dominates for $Ri > 0.8$ and symmetric baroclinic instability dominates for $Ri < 0.8$. However, for $\sigma = 1$ in the range $0.3 \leq Ri \leq 0.8$, conventional baroclinic instability always dominates. Further, it was found for $\sigma \leq 1$ that when symmetric instability dominates, the mode of maximum growth rate is not purely symmetric but has weak zonal structure. This means that the wave fronts are inclined at a small angle to the basic state flow. For these weak zonal modes it was also found that the critical Richardson number is increased by a small amount above its value for pure symmetric instability. Because these modes differ so slightly from the pure symmetric modes, it is unlikely that they represent a new mode of instability.

TP-2456 December 1984
An Integral Representation of the Generalized Euler-Mascheroni Constants. O. R. Ainsworth and L. W. Howell. Systems Dynamics Laboratory. N85-23305

The limit series for the Euler-Mascheroni constants is represented as an integral. Using this new representation, we compute the first 200 values and assorted others up to 2000. The first 13 roots of γ_n , where n is a positive continuous variable, are also given.

NASA TECHNICAL PAPERS

TP-2459 January 1985

An Electrochemical Study of the Corrosion Behavior of Primer Coated 2219-T87 Aluminum. Merlin D. Danford and Ralph H. Higgins. Materials and Processes Laboratory. N85-22662

The corrosion behavior for 2219-T87 aluminum coated with various primers, including those used for the External Tank and Solid Rocket Boosters of the Space Shuttle Transportation System, has been investigated using electrochemical techniques. Corrosion potential-time, polarization resistance-time, electrical resistance-time, and corrosion rate-time measurements were all investigated. It was found that electrical resistance-time and corrosion rate-time measurement were most useful for studying the corrosion behavior of painted aluminum. Electrical resistance-time determinations give useful information concerning the porosity of paint films, while corrosion rate-time curves give important information concerning overall corrosion rates and corrosion mechanisms. In general, the corrosion rate-time curves all exhibited at least one peak during the 30 day test period, which was attributed, according to the proposed mechanisms, to the onset of the hydrogen evolution reaction and the beginning of destruction of the protective properties of the paint film.

TP-2469 March 1985

Adding Computationally Efficient Realism to Monte Carlo Turbulence Simulation. C. Warren Campbell. Systems Dynamics Laboratory. N85-28708

Frequently in aerospace vehicle flight simulation, random turbulence is generated using the assumption that the craft is small compared to the length scales of turbulence. The turbulence is presumed to vary only along the flight path of the vehicle but not across the vehicle span. The addition of the realism of three-dimensionality is a worthy goal, but any such attempt will not gain acceptance in the simulator community unless it is computationally efficient. A concept for adding three-dimensional realism with a minimum of computational complexity is presented. The concept involves the use of close rational approximations to irrational spectra and cross-spectra so

that systems of stable, explicit difference equations can be used to generate the turbulence.

TP-2474 January 1985

A Critical Evaluation of Various Turbulence Models As Applied to Internal Fluid Flows. M. Nallasamy. Systems Dynamics Laboratory. N85-25757

The report presents a brief account of various turbulent models employed in the computation of turbulent flows, and evaluates the application of these models to internal flows by examining the predictions of various turbulence models in selected important flow configurations. The main conclusions of this analysis are: (a) The $k-\epsilon$ model is used in a majority of all the two-dimensional flow calculations reported in the literature. (b) Modified forms of the $k-\epsilon$ model improve the performance for flows with streamline curvature and heat transfer. (c) For flows with swirl, the $k-\epsilon$ model performs rather poorly; the algebraic stress model performs better in this case. (d) For flows with regions of secondary flow (noncircular duct flows), the algebraic stress model performs fairly well for fully developed flow. For developing flow, the algebraic stress model performance is not good; a Reynolds stress model should be used.

Two important factors in the numerical solution of the model equations, namely false diffusion and inlet boundary conditions, are discussed. The existence of countergradient transport and its implications in turbulence modeling are mentioned. Two examples of recirculating flow predictions obtained using PHOENICS code are discussed. Other approaches to turbulent flow computations, such as the vortex method, large eddy simulation (modeling of subgrid scale Reynolds stresses), and direct simulation, are briefly discussed. Finally, some recommendations for improving the model performance are made. The need for detailed experimental data in flows with strong curvature is emphasized.

TP-2476 March 1985

Formulation/Cure Technology for Ultra-High Molecular Weight Silphenylene-Siloxane Polymers. N. H. Hundley and W. J.

Patterson. Materials and Processes Laboratory.
N85-26990

Molecular weights above one million were achieved for methylvinylsilphenylene-siloxane terpolymers using a two-stage polymerization technique which was successfully scaled up to 200 grams. The resulting polymer was vulcanized by two different formulations and compared to an identically formulated commercial methylvinyl silicone on the basis of ultimate strength, Young's modulus, percent elongation at failure, and tear strength.

Relative thermal/oxidative stabilities of the elastomers were assessed by gradient and isothermal thermogravimetric analyses performed in both air and nitrogen. The experimental elastomer exhibited enhanced thermal/oxidative stability and possessed equivalent or superior mechanical properties.

The effects of variations in prepolymer molecular weight on mechanical properties was also investigated.

TP-2486 April 1985
Fluid Surface Behavior in Low Gravity, Center Discretionary Fund No. 83-21, Final Report. Fred Leslie, Roger F. Gans, and Charles Schafer. Systems Dynamics Laboratory. N85-28260

Measurements of rotating equilibrium bubble shapes in the low-gravity environment of a free-falling aircraft are presented. Emphasis is placed on bubbles which intersect the container boundaries. These data are compared with theoretical profiles derived from Laplace's formula and are in good agreement with the measurements. Two types of instability are explored. The first occurs when the baffle spacing is too large for the bubble to intersect both the top and bottom boundaries. The second occurs when the hydrostatic pressure beneath a displaced free surface does not compensate for pressure change due to capillary forces. The interface shape depends on the contact angle, the radius of intersection with container, and the parameter F , which is a measure of the relative importance of centrifugal force to surface tension. For isolated

bubbles, F has a maximum value of $1/2$. A further increase in F causes the bubble to break contact with the axis of rotation. For large values of F , the bubble becomes more cylindrical and the capillary rise occurs over a thinner layer so that the small radius of curvature can generate enough pressure drop to balance the increased hydrostatic contribution.

TP-2489 April 1985
Convergence of Newton's Method for a Single Real Equation. C. Warren Campbell. Systems Dynamics Laboratory. N85-28656

Newton's method for finding the zeroes of a single real function is investigated in some detail. Convergence is generally checked using the Contraction Mapping Theorem which yields sufficient, but not necessary, conditions for convergence of the general single point iteration method. The resulting convergence intervals are frequently considerably smaller than actual convergence zones. For a specific single point iteration method, such as Newton's method, better estimates of regions of convergence should be possible. A technique is described which, under certain conditions (frequently satisfied by well behaved functions), gives much larger zones where convergence is guaranteed.

TP-2494 March 1985
Recovery of Pyroshock Data from Distorted Acceleration Records. James Lee Smith. Systems Dynamics Laboratory. N85-31141

In the past, distorted pyrotechnic shock time history data has been discarded completely or "cleaned up" by questionable means. Too often the "clean up" procedures introduced as much error into the data as previously existed. The purpose of this paper is to outline techniques for data recovery so that true signals are obtained and so that these recovery procedures will be completely reproducible by any scientist in any lab. Most ordnance shock data is distorted by baseline shifts or accelerometer resonances. The methodology of recovering true signals from these two types of distortion is discussed.

TP-2507 May 1985
Procedure for Estimating Orbital Debris

Risks. James L. Crafts and James P. Lindberg. Systems Analysis and Integration Laboratory.

This report presents a procedure for estimating the potential orbital debris risk to the world's populace from payloads or spent stages left in orbit on future missions. This approach provides a consistent, but simple, procedure to assess the risk due to random reentry with an adequate accuracy level for making programmatic decisions on planned low Earth orbit missions.

TP-2508 May 1985
Problems Experienced and Envisioned for Dynamical Physical Systems. Robert S. Ryan. Systems Dynamics Laboratory.

The use of high performance systems, which is the trend of future space systems, naturally leads to lower margins and a higher sensitivity to parameter variations and, therefore, more problems of dynamical physical systems. To circumvent dynamic problems of these systems, appropriate design, verification analysis, and tests must be planned and conducted. The basic design goal is to define the problem before it occurs. The primary approach for meeting this goal is a good understanding and reviewing of the problems experienced in the past in terms of the system under design.

This paper reviews many of the dynamic problems experienced in space systems design and operation, categorizes them as to causes, and envisions future program implications, developing recommendations for analysis and test approaches.

TP-2510 May 1985
Potential Spin-Offs of the Carbon Dioxide Observational Platform System (CO-OPS) for Remote Sensing Opportunities. J. Briscoe Stephens. Systems Dynamics Laboratory.

Alternate remote sensing techniques that could utilize the slight losses of energy from the microwave beam which powers the NASA/MSFC Carbon Dioxide Observational Platform System (CO-OPS) to achieve the objectives of the U.S. Department of Energy (DOE) Carbon Dioxide Research Program's regional observational data requirements, ODRs, are addressed heuristically.

The opportunity for regional remote sensing of the carbon dioxide and water vapor constituents in the atmosphere are discussed as a potential spin-off of the CO-OPS. The CO-OPS is envisioned as a high altitude (~25 km) observational platform system powered by microwave energy for regional observational use by the DOE in their Carbon Dioxide Research Program.

TP-2511 May 1985
Space Station Rotational Equations of Motion. Mario H. Rheinfurth and Stanley N. Carroll. Systems Dynamics Laboratory.

Dynamic equations of motion are developed which describe the rotational motion for a large space structure having rotating appendages. The presence of the appendages produce torque coupling terms which are dependent on the inertia properties of the appendages and the rotational rates for both the space structure and the appendages. These equations were formulated to incorporate into the Space Station Attitude Control and Stabilization Test Bed to accurately describe the influence rotating solar arrays and thermal radiators have on the dynamic behavior of the Space Station.

NASA CONFERENCE PUBLICATIONS

CP-2364

Applications of Tethers in Space, Volume 1 of 2. Compiled by Alfred C. Cron. Program Development, Marshall Space Flight Center. N85-20339

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Applications of Tethers in Space, Volume 2 of 2. Compiled by Alfred C. Cron. Program Development, Marshall Space Flight Center. N85-20361

CP-2366

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February 1985

Proceedings of MSFC Advanced High Pressure O_2/H_2 Technology Conference 1984. Edited by S. F. Morea and S. T. Wu. Research and Technology Office, Marshall Space Flight Center. N85-26862

CP-2374

December 1984

MSFC Workshop on Measurements of Solar Vector Magnetic Fields. Edited by Mona J. Hagyard. Marshall Space Flight Center. N85-29869

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July 1985

Meteorological and Environmental Inputs to Aviation Ssystems. Edited by Dennis W. Camp and Walter Frost. Systems Dynamics Laboratory.

CP-2391

July 1985

Second Workshop on Spacecraft Glow. J. H. Waite, Jr. and T. W. Moorehead, Editors. Marshall Space Flight Center.

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September 1985

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Simulation of Solidification in a Bridgman Cell. Youssef M. Dakhoul and Richard C. Farmer. NAS8-35331. Continuum, Inc. N85-11314
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Convective Storm Downdrift Outflows Detected by NASA/MSFC's Airborne 10.6 μ m Pulsed Doppler Lidar System. G. D. Emmitt. NAS8-35597. Simpson Weather Associates, Inc. N85-28511
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A Root-Mean-Square Pressure Fluctuations Model for Internal Flow Applications. Y. S. Chen. NAS8-35918. Universities Space Research Association.
- CR-3929 July 1985
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- CR-3945 May 1985
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- CR-3946 November 1985
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- CR-171152 September 1981
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- CR-171161 July 1984
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- CR-171162 September 1984
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- CR-171163 July 1984
Surface Analysis of Space Telescope Material Specimens, Monthly Report for July. NAS8-35914. Auburn University.
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ANDREWS, J. B.
JOHNSTON, M. H.
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WAITE, J. HUNTER, JR.
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Are There Constant-Alpha Force-Free Magnetic Fields in Solar Active Regions? For presentation at the Annual Meeting of the Solar Physics Division of the American Astronomical Society, Tucson, AZ, May 13-15, 1985.</p> <p>HAGYARD, M. J. ES52
The Relation of Sheared Magnetic Fields to the Occurrence of Flares. For publication in Artificial Satellites.</p> <p>HAGYARD, M. J. ES52
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The Vertical Gradient of Sunspot Magnetic Fields. For presentation at the Ron Giovanelli Commemorative Colloquium, Tucson, AZ, January 17-18, 1985.</p> <p>HATHAWAY, D. H. ES52
Jupiter and Saturn's Magnetic Differential Rotation and Expected Periods of Magnetic Field Reversals. For presentation at the 17th Annual Meeting of the Division of Planetary Sciences of the AAS, Baltimore, MD, October 29-November 1, 1985.</p> <p>HATHAWAY, DAVID H. ES52
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Flow Regimes in a Shallow Rotating Cylindrical Annulus with Temperature Gradients Imposed on the Horizontal Boundaries. For publication in the Journal of Fluid Mechanics, Cambridge, England.</p> <p>HATHAWAY, D. H. ES01
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| <p>HILCHEY, JOHN D. PS02
 ARNO, ROBERT ARC/LB
 Space Station Life Sciences Accommodations Optimizing the Return. For presentation at the 15th Intersociety Conference on Environmental Systems, San Francisco, CA, July 15, 1985.</p> <p>HILDNER, ERNEST ES52
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 SMITH, O. E.
 Aerospace Meteorology, Design Criteria, and Mission Analysis for National Space Transportation System. For presentation at the AIAA 24th Aerospace Sciences Meeting, Reno, NV, January 6-9, 1986.</p> <p>HILL, CHARLES K. ED44
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 DESSLER, A. J.
 Remote Sensing of the Magnetic Moment of Uranus: Predictions for Voyager. For publication in Science, Washington, D.C.</p> <p>HINMAN, ELAINE M. EB24
 YORCHAK, JOHN MMC
 HARTLEY, CRAIG MMC
 Characterization of Good Teleoperators: What Aptitudes, Interests, and Experience Correlate with Measures of Teleoperator Performance. For presentation at the 29th Annual Meeting of the Human Factors Society, Baltimore, MD, September 1985.</p> | <p>HOCKMAN, R. EH14
 ERDEMIR, A.
 DOLAN, F.
 THOM, R.
 The Relation of the Properties of Cu, Ti and TiN Coatings to Rolling Contact Fatigue. For presentation at the 12th International Conference on Metallurgical Coatings, Los Angeles, CA, April 15-19, 1985.</p> <p>HOFMEISTER, W. H. ES72
 EVANS, N. D.
 BAYUZICK, R. J.
 ROBINSON, M. B.
 Microstructures of Niobium-Germanium Alloys Processed in Inert Gas in the 100 Meter Drop Tube. For publication in Metallurgical Transactions, Pittsburgh, PA.</p> <p>HOOVER, RICHARD B. ES52
 CHAO, S. H.
 SHEALY, D. L.
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 Hybrid X-Ray Telescope System. For presentation at the Grazing Incidence Optics, SPIE 1986 Tech. Sym. Southeast on Optics and Optoelectronics, Orlando, FL, March 31-April 4, 1986, and for publication in the SPIE Conference Proceedings.</p> <p>HOOVER, R. B. ES01
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 HOOVER, MIRIAM J.
 AL-MUFTI, S.
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HORWITZ, J. L. ES53

MOORE, T. E.

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HUMPHRIES, W. R.

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The Roll of Energetic O ⁺ Precipitation in a Mid-Latitude Aurora. For publication in the Journal of Geophysical Research, Washington, D.C. | ES55 | KAUFMANN, R. L.
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| JOHNSON, G.
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A Mathematical Formulation of the Problem of Optimal Use of Ground Resources for Future Space Missions. For publication in The European Journal of Operations Research, Amsterdam, The Netherlands. | PD34 | KAUKLER, WILLIAM
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Solidification Interface Morphology of Monotectic Systems. For presentation at the 1985 TMS-AIME Fall Meeting, Toronto, Canada, October 13-17, 1985. | ES73 |
| JOHNSTON, M. H.
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The Influence of Varying Gravity Forces on the Solidification of Alloys. For presentation at the Space Tech. Conference and Exposition, Anaheim, CA, September 23-25, 1985. | EH22 | KAUKLER, WILLIAM F.
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Space Shuttle Exhaust Cloud: Microphysical Properties Summary. For presentation at the JANNAF Workshop on Atmospheric Transport and Diffusion Modeling, Los Angeles, CA, June 11-13, 1985. | ED44 |
| JONES, CLYDE S., III
Application of Intelligent Robotic Welding Systems for Fabrication of Aerospace Hardware. For presentation at the Space Tech. Conference and Exposition, Anaheim, CA, September 23-25, 1985. | EH42 | KELLER, VERNON W.
Large Volume Water Sprays for Dispersing Warm Fogs. For presentation at the International Conference of Liquid Atomisation and Spray Systems, London, England, July 8-10, 1985. | ED44 |
| KAHLER, S. W.
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Filament Eruptions During Flare Impulsive Phase. For presentation at the Fall Meeting of the American Geophysical Union, San Francisco, CA, December 3-7, 1984, and for publication in EOS. | ES52 | KELLER, VERNON W.
Demonstration of a New Method for Dispersing Warm Fogs. For presentation at the Conference on Aerospace and Range Meteorology, American Meteorological Society, Huntsville, AL, August 27-29, 1985. | ED44 |
| | | KENT, G. S., et al.
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| <p>KLUMPAR, D. M. ES53
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The Latitudinal Structure of Ion Inverted-V's. For presentation at the Fall Meeting of the American Geophysical Union, San Francisco, CA, December 3-7, 1984.</p> | <p>Planned Directional Solidification Crystal Growth of $Hg_{1-x}Cd_xTe$ In Space. For presentation at the 115th TMS-AIME Annual Meeting, New Orleans, LA, March 2-6, 1986.</p> |
| <p>KROES, R. L. ES72
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Growth of TGS Crystals on Spacelab 3. For presentation at the 115th TMS-AIME Annual Meeting, New Orleans, LA, March 2-6, 1986.</p> | <p>LESLIE, FRED ED42
Measurements of Rotating Bubble Shapes in a Low Gravity. For publication in the Journal of Fluid Mechanics.</p> |
| <p>LAL, R. B. ES72
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Growth of Triglycine Sulfate Crystals Aboard Spacelab-3 Mission. For presentation at the Alabama Academy of Science Meeting at University of Alabama In Huntsville, March 27-31, 1985.</p> | <p>LOCKWOOD, M. ES53
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HORWITZ, J. L.
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| <p>LEE, Y. G. ES73
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Molecular Interaction of Dinitriles with Copper Surfaces. For presentation at the 62nd Annual Meeting of the Alabama Academy of Science, Huntsville, AL, March 27-30, 1985.</p> | <p>LOCKWOOD, M. ES53
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| <p>LEHOCZKY, S. L. ES72
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| <p>LEHOCZKY, S. L. ES72
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| LOO, B. H. | ES73 | Space Vehicle Glow Measurements on STS 41-D. For publication in the Journal of Spacecraft and Rockets, Gainesville, VA. |
| LEE, Y. G. | | |
| FRAZIER, D. O. | | |
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| Enhanced Raman Spectroscopic Study of the Coordination Chemistry of Malononitrile on Copper Surfaces: Removal of V(C≡N) Degeneracy Through π -Coordination. For publication in Chemical Physics Letters, Stanford, CA. | | |
| McCAY, T. DWAYNE | EP26 | |
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| MEEGAN, C. A. | ES62 | |
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| The Frequency of Weak Gamma-Ray Bursts. For publication in the Astrophysical Journal. | | |
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| MILLER, JOHN Q. | EP25 | |
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| MILLER, TIMOTHY L. | ED42 | |
| ANTAR, BASIL N. | | |
| Three-Dimensional Baroclinic Instability at Small Richardson Number. For presentation at the Fifth Conference on Atmospheric and Oceanic Waves and Stability, New Orleans, LA, March 4-7, 1985. | | |
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| WILLIAMS, GEORGE O. | | |
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| <p>MITCHELL, ROYCE E. TA81
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Flux Submergence, Magnetic Shear, and the Solar Cycle. For presentation at the Ron Giovanelli Commemorative Colloquium, Tucson, AZ, January 17-18, 1985.</p> <p>MOORE, RONALD L. ES52
RABIN, DOUGLAS UAH/MSFC
Sunspot Oscillations and the Short-Period Cutoff for Global P-Mode Oscillations. For presentation at the 165th Meeting of the American Astronomical Society, Tucson, AZ, January 14-16, 1985, and for publication in the Bulletin AAS.</p> <p>MOORE, RONALD ES52
Magnetic Structures in the Solar Atmosphere. For publication in the Proceedings of the High Energy Solar Physics Symposium, Tokyo, Japan.</p> <p>MOORE, RONALD L. ES52
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Implications of Solar Flare Dynamics for Reconnection in Magnetospheric Substorms. For publication in Planetary and Space Science, Ireland.</p> <p>MOORE, T. E. ES53
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KILLEEN, T. L.
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Solar Wind Control of the Geomagnetic Mass Spectrometer. For presentation at the AGU Chapman Conference on Solar Wind/Magnetosphere Coupling, Pasadena, CA, January 12-15, 1985.</p> <p>MORGAN, S. H. ES72
SILBERMAN, E.
KROES, R. L.
REISS, D.
Raman Determination of the Composition of Concentrated Aqueous Solutions of Triglycine Sulfate. For publication in Applied Spectroscopy, Sweden.</p> |
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- MORRIS, DANIEL J. ES62
Low-Energy Gamma-Ray Scattering in the Atmosphere and in Spacecraft. For publication in Nuclear Instruments and Methods in Physics Research, Section A, Amsterdam, Holland.
- NALLASAMY, M. ED42
Turbulence Model Predictions of Confined Plane Two-Dimensional and Axisymmetric Flows. For presentation at the AIAA Applied Aerodynamics Conference, Colorado Springs, CO, October 14-16, 1985.
- NAUMANN, ROBERT J. ES71
Space Station — The Base for Tomorrow's Electronic Industry. For presentation at Space Station: Gateway to Space Manufacturing and Services, Orlando, FL, November 7-8, 1985.
- NAUMANN, R. J. ES71
SNYDER, R. S.
BUGG, C. E.
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Letter Answering Article (July 26, p. 370) Entitled "The Great Crystal Caper." For publication in Science (Letter), New York, NY.
- NAUMANN, R. J. ES71
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- NAUMANN, R. J. ES71
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Space Shuttle Molecular Scattering and Wake Vacuum Measurements. For presentation at the 1984 American Vacuum Society National Symposium, Reno, Nevada, December 4, 1984.
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- NAUMANN, ROBERT J. ES71
Materials Processing in Space: The New Industrial Frontier. For presentation at the Space Technology Conference and Exposition on the Commercialization of Space, Zurich, Switzerland, June 20, 1984.
- NERNEY, STEVEN SFF
SUESS, S. T. ES52
Modelling the Effects of Latitudinal Gradients in the Solar Wind in the Outer Solar System. For publication in the Astrophysical Journal, Chicago, IL.
- NERNEY, STEVEN
(U.S. Naval Postgraduate School)
SUESS, S. T. ES52
Modelling the Effects of Latitudinal Gradients in the Solar Wind in the Outer Solar System. For publication in the Astrophysical Journal.
- NESMAN, TOMAS E. ED24
REED, DARREN K.
SAFE/DAE: Modal Test in Space. For presentation at the 56th Shock and Vibration Symposium, Monterey, CA, October 22-24, 1985.
- NEVINS, C. D. EP11
Improving Productivity and Quality Through Computer Aided Design. For presentation at the NASA Second Annual Contractor Conference (Hardware), Huntsville, AL, June 12-13, 1985.
- OLSEN, R. C. ES53
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The Hidden Ion Population — Revisited. For publication in the Journal of Geophysical Research, Washington, D.C.

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- VON PRAGENAU, GEORGE L. ED14
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Compiled by Joyce E. Turner

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C. D. BEAN

Director, Administrative Operations Office